Reviews

SUMMARY OF THE LITERATURE OF NORTH AMERICAN PLEISTOCENE GEOLOGY 1901 AND 1902. II.

FRANK LEVERETT.

CENTRAL AND EASTERN CANADA.

BELL, ROBERT. *Report of an Exploration on the Northern Side of Hudson Strait.* Geol. Survey Canada, Ann. Report, Vol. XI, Part M, 38 pp., 1901.

Baffin Land, which forms the northern side of Hudson Strait, was until 1875 supposed to consist of a group of islands, but now it appears to be one great island with an area of about 300,000 square miles. There are, however, numerous small islands along the south coast. Three prominent mountain ranges trend north-northwest to south-southeast parallel with the eastern coast, the highest of which borders that coast. The high interior north of Cumberland Sound is reported by Boas to be ice-capped like Greenland. Around the margins of the ice-cap the general elevation is about 5,000 feet, and it reaches about 8,000 feet in the central part. Another area of smaller extent, but apparently equally high, lies a short distance farther northwest. The mountainous region between Cumberland Sound and Frobisher Bay stands apparently between 2,000 and 3,000 feet. The tract between Hudson Strait and Frobisher Bay is largely covered by the Grinnell glacier, which is 70 to 100 miles in length and about 20 miles in breadth. It was reported (but not verified) that one narrow tongue of ice extends down to the water of the strait. The mountains are apparently interspersed with lakes, two of which are of great size, Lake Netelling being 60 by 140 miles, and Lake Amadjuak at least 40 by 120 miles. Their greatest diameter runs parallel with the mountain ranges north-northwest to south-southeast.

Hudson Strait, as pointed out in 1895[1] was probably occupied by a river that drained the Hudson Bay basin at a time of high altitude when the basin was dry land. Soundings show the strait to have a channel 200 to 300 fathoms in depth. The ice-sheets of the glacial period moved down from the high land on both sides, and then down the valley itself, as shown by the striation and the materials of the drift.

On the part of Baffin Land examined, bowlders are a conspicuous feature, and a sandy or gravelly till is abundant. Osars were noted southwest of Amadjuak Lake. The general glaciation seems likely to have been rather remote, for the surface of the drift is much oxidized, and the limestone surfaces show considerable decay. Striæ are conspicuous only at low levels along the coast. A table containing observations of twenty-two striæ is given. Giant potholes 8 to 20 feet in diameter were noted on the border of the entrance to Canon Inlet.

The sea has stood at various levels, above the present, long enough to form well-defined beaches. Beaches were noted at several points at elevations of 360 to 400 feet, as well as at various lower altitudes. On a mountain side west of Akuling Inlet

[1] In a paper by DR. BELL in the *Scottish Geographical Magazine.*

beaches and terraces were found at 378 and 528 feet. Drinkwater reports observing a beach about 600 feet above the sea on the hills above O'Brien Harbor at Cape Chidley. Shells of *Saxicava rugosa* and *Mya truncata* were found imbedded in till on one of the Islands of God's Mercie at 200 feet, and the Saxicava shells in drift at lakes Gertrude and Greely at 110 feet.

CHALMERS, ROBERT. *Notes upon the Pleistocene Marine Shore Lines and Land Slips of the North Side of the St. Lawrence Valley.* Geol. Survey Canada, Vol. XI, Part J, Appendix I, pp. 63–70, 1901.

The marine plain or bottom land of the St. Lawrence valley extends from 8 to 30 miles north of the river in the district between Quebec and Montreal. The river bank is usually but 15 to 25 feet, but in passing back toward the northern limits, along the base of the Laurentian hills, there is a rise to 400 or 500 feet. The slope is terraced, apparently by marine shore action. The shore lines are found to increase in height from east to west, the rate of rise of the highest one between Quebec and Lachute being about two feet per mile.

The landslips here reported have occurred at various dates from 1840 to 1898, and lie below the level of the highest shore line. The most recent one, May 7, 1898, filled the Rivière Blanche valley 25 feet for a distance of nearly two miles. The cause of the landslips is stated by the author to be due to (1) the silty and arenaceous character of the Leda clay, rendering it capable of absorbing and retaining a large amount of water, and (2) the increased precipitation during the season these landslips occurred, which saturated the deposit and gave them greater weight than usual.

CHALMERS, ROBERT. *Surface Geology of Part of Ontario.* Geol. Survey Canada, Summary Rept. for 1901, pp. 158–68.

In company with R. W. Ells, the western limit of marine beds was traced northward from Brockville to Smiths Falls. Clay thought to be of fresh-water deposition was noted at Lyn, Gananoque, Kingston, and westward.

Oil wells at Petrolia, Oil Springs, and Sarnia penetrate 100 to 125 feet of surface deposits before striking rock. Rock is reached near Bothwell at 210 feet and at Dutton at 255 feet, while at Tilsonburg it is reached at 74 to 81 feet.

In parts of the Thames valley gas is obtained from sand and gravel below hardpan at a depth of about 90 feet.

The following series of drift beds is reported to occur in western Ontario:

1. Surface clay, sand, or gravel, more or less oxidized.
2. Bowlder clay of irregular thickness, sometimes wanting.
3. Sandy and silty beds, in places forming the upper part of the Saugeen clay (interglacial).
4. Saugeen clay, interglacial, partially oxidized and somewhat sandy in upper part, fresh-water shells in lower part.
5. Erie clay, interglacial, color bluish-gray, sometimes darker, stratification more or less distinct; contains fresh-water and land shells (Campeloma, Succinea, Polygyra, etc.), in upper part; localities noted are Pelee Island and shore of Lake Erie.
6. Bowlder clay, usually a thin sheet resting either on the decomposed or the solid surface of the "fundamental rocks."

The so-called interglacial beds Nos. 3 to 5 often have a combined thickness of 100 to 150 feet.

A former level of the Great Lakes lower than the present is shown by the following lines of evidence: (1) by stumps along the Lake Erie shore west of Port Rowan with their roots in soil below lake level; (2) by tree trunks in a layer of clay and marl in the mouth of Maitland River at Goderich 10 to 15 feet below the level of Lake Huron; (3) streams discharging into Lakes Huron, St. Clair, Erie, and Ontario have their lower courses flooded from the lakes. In the case of the Thames and the Sydenham the depth of flooding is 10 to 25 or 30 feet, and extends for several miles up the stream.

Spits and dunes on the north shore of Lake Erie are being built mainly by winds that blow from the southwest, those on the north shore of Lake Ontario by winds blowing from the east.

COLEMAN, A. P. *Marine and Freshwater Beaches of Ontario.* Bull. Geol. Soc. Amer., Vol. XII, pp. 129–46, 1901.

Marine deposits and shell-bearing gravel and sand extend up the St. Lawrence valley to Brockville, both on the Ontario and New York side, but have not been found farther west, though the same body of water is known to have extended into the Ontario basin. Plant remains found in clay nodules in Ottawa are those of a cool-temperate climate like the present climate of that region. The remains of marine animals are of species found now in the Gulf of St. Lawrence.

Higher shore lines are found, and other evidences of static water at high levels, but the author doubts if any of these higher shore lines are postglacial and marine. On the contrary, they appear to have been produced by glacial lakes. In some cases the beaches contain fresh-water fossils.

Attention is called to evidences of northward differential uplift in the Great Lakes region, and it is considered probable that the highest beaches were formed at a comparatively slight altitude above the sea. The objection raised against ice-dams, that no glacial mass could withstand the pressure of a head of water hundreds of feet in depth, may find no application here if the land was relatively low, and is thought to be of doubtful pertinence even under conditions of high altitude.

COLEMAN, A. P. *Sea Beaches of Eastern Ontario.* Rept. of Ontario Bureau of Mines for 1901, pp. 215–27.

Describes the character and distribution of the sea beaches and the faunas which they contain. Also gives a few observations on the Leda clay and the Saxicava sand.

COLEMAN, A. P. *Iron Ranges of the Lower Huronian* [Ontario]. Rept. of Ontario Bureau of Mines for 1901, pp. 181–211.

Although dealing chiefly with the iron-ore bodies, a brief discussion of the Pleistocene geology is presented.

COLEMAN, A. P. *Glacial and Interglacial Beds near Toronto.* Jour. Geol., Vol. IX, pp. 285–310, 1901.

Presents a connected history of events in the Ontario basin from the retreat of the Iowan ice-sheet, which is summed up as follows:

1. Retreat of the Iowan ice-sheet.
2. Interval of erosion, with water probably lower than at present.
3. Don stage, warm-climate trees, and Mississippi unios, water dammed by differential elevation toward the northeast to 60 feet above the present lake.

4. Scarboro peaty clays, cold-temperate climate with trees and mosses, and 70 species of extinct beetles, formed as a delta by Laurentian River in interglacial Scarboro Bay.

5. Scarboro stratified sand with some trees and freshwater shells of cold-temperate climate, delta completed; lake stood 152 feet above the present.

6. Water drawn off by lowering of outlet, subaërial erosion of previous beds, and cutting of river valleys more than 150 feet deep.

7. Advance of Wisconsin ice-front raising the water to about 160 feet, as shown by stratified interglacial clay, retreat for 50 miles and readvance, followed by two later retreats and advances, the water finally rising 360 feet above the present lake.

8. Final retreat of ice-sheet followed by water levels of lakes Warren and Iroquois, and a brief entry of the Gulf of St. Lawrence into the Ontario basin, which, however, remained fresh.

The reviewer questions whether the Iowan drift is well represented or even present at this locality, since the interval shown by the interglacial beds appears to be much greater than observations in the region where Iowan and Wisconsin drift sheets are well displayed would lead one to expect. This does not invalidate in any way the conclusions announced in this paper; it simply suggests that the lower till sheet may be Illinoian.

COLEMAN, A. P. *Duration of the Toronto Interglacial Periods.* Am. Geol., Vol. XXIX, pp. 71–79, 1902.

In reply to a paper by Upham which had appeared in the *American Geologist*, Coleman estimates the time required for the processes which took place between the two advances of the ice. Of this time 1,300 years is considered a low estimate for laying down the interglacial beds and 2,500 years for trenching them; it is considered probable that the time should be more than doubled. The warm-climate flora is shown to be inconsistent with the view that the ice-sheet was near by. The author holds it probable that the ice had disappeared as completely from Canada in that interglacial period as at the present time, which perhaps is embraced in another interglacial period.

COLEMAN, A. P. *Relation of Changes of Levels to Interglacial Periods.* Geol. Mag., Dec. 4, Vol. IX, pp. 59–62, 1901.

It is thought there was an uplift to the northeast, followed by a depression. The uplift would render Labrador cooler and help start an ice accumulation, and this in turn would tend to depress the region. The melting of the last ice-sheet would allow the land to rise again. It is a problem whether this elevation to the northeast would be sufficient of itself to cause glaciation.

CURRIE, P. W. *On the Ancient Drainage at Niagara Falls.* Trans. Can. Inst., Vol. VII, pp. 7–14, 6 pls., 1901.

(Not examined.)

DOWLING, D. B. *Physical Geography of Red River Valley.* Ottawa Nat., Vol. XV, pp. 115–20, 1901.

The geological history is sketched, and with it the development of the main physical features. The effect of glaciation and of the occupancy by the Glacial Lake Agassiz form the closing part of the discussion.

DOWLING, D. B. *West Shore and Islands of Lake Winnipeg.* Geol. Survey Canada, Ann. Rept., Vol. XI, Part F, 100 pp., 1901. Published as a separate in 1899.

Superficial deposits are discussed on pp. 93–100, and include till, drumlins, reassorted bowlder clay, stratified sands and gravels, and lake beaches. The bearings of striæ are also given, and a map of part of Lake Winnepeg shows striæ and drumlins.

DOWLING, D. B. *East Shore of Lake Winnipeg and Adjacent Parts of Manitoba and Keewatin.* Geol. Survey Canada, Ann. Rept., Vol. XI, Part G, 98 pp. 1901. Published as a separate in 1899.

This report is edited from notes by J. B. Tyrrell. While dealing mainly with the hard-rock geology, there are brief references at various points to glacial deposits, lacustrine deposits, striæ, potholes, etc. The eastern limit of lacustrine deposits is noted (p. 43).

DOWLING, D. B. *The West Side of James Bay.* Geol. Survey Canada, Summary Rept. for 1901, pp. 107–15, 1902.

A traverse was made on the west shore of James Bay, and a survey of Equan River. The deltas of Moose and Albany rivers are briefly described. Clays with marine fossils occur up to nearly 400 feet above tide in the vicinity of Sutton Mill Lake.

DOWLING, D. B., and J. B. TYRRELL. (See Tyrrell.)

ELLS, R. W. *Three Rivers Map Sheet of Quebec.* Geol. Survey Canada, Ann. Rept., Vol. XI, Part J, pp. 63, 1901. (Published as a separate in 1900.)

The occurrence of marine shells in sand or gravel above clay is apparently restricted to the vicinity of the St. Lawrence River, none having been noted on the high areas to the north. Striæ are rather rare because of the limited outcrop of Paleozoic rocks and because weathered quickly from the gneiss. The general bearing is north-south.

ELLS, R. W. *Ancient Channels of the Ottawa River.* Ottawa Nat., Vol. XV, pp. 17–30, with map, 1901.

The paper opens with a reference to the Ottawa as one of the great historic waterways, Champlain having ascended it in 1615, and crossed the portage at Lake Nipissing, "presumably the first white man to gaze upon the vast expanse of our inland seas," while afterward the river became the chosen route of the voyageurs inland to the great unexplored country, and the principal channel for the business of the Hudson Bay Company. The geologic history of the river is made to begin far back of the Glacial epoch, though it is recognized that marked changes were produced by glaciation. Borings show that part of the lower course has a rock floor below the sea level, and the depth of Lake Temiscaming (470 feet) brings its bottom to within 121 feet of sea level. The valley is thought to have experienced several cycles of uplift and depression. The author inclines to the view that a postglacial marine submergence covered lands between the Ottawa and Hudson Bay now standing over 1,000 feet above sea level.

The paper deals mainly with the departures of the present stream from a deep

preglacial channel, the course of which was determined by borings, and is represented on a map for a distance of about 200 miles, from Roche Capataine, in longitude 78° nearly to Montreal.

ELLS, R. W. *The District around Kingston, Ontario.* Geol. Survey Canada, Summary Rept. for 1901, pp. 170–83.

Notes briefly marine deposits at Brockville, the probable Iroquois shore line near Tamworth, and the occurrence of shell marl in many lakes in the area north of Kingston.

ELLS, R. W. *Marl Deposits of Eastern Canada.* Ottawa Nat., Vol. XVI, pp. 59–69, 1902.

Discusses deposits in Ontario, Quebec, New Brunswick, and Nova Scotia, and refers the deposition of marl to the action of air upon spring water containing bicarbonate of lime.

FLETCHER, HUGH. *Kings and Hauts Counties, Nova Scotia.* Geol. Survey Canada, Summary Rept. for 1901, pp. 208–14.

Refers briefly (p. 211) to drift material, striæ, old beaches, and shell marl.

JOHNSTON, J. F. E. *Eastern Part of the Abitibi Region.* Geol. Survey, Canada, Summary Rept. for 1901, pp. 128–41.

Describes briefly the streams, lakes, peat, timber, soils, fish and game, as well as the hard-rock geology.

LAFLAMME, J. C. K. *Geological Exploration of Anticosti.* Geol. Survey Canada, Summary Rept. for 1901, pp. 188–94.

The stream valleys are largely excavated in gravel and calcareous detritus of modern origin, and postglacial clays are also present. A few striæ bearing northeast-southwest were found at Rivière Du Cap. The highest parts of the island carry glacial bowlders. The island was apparently covered by the Champlain sea. The uplift following the submergence is distinctly marked, and the two phases of it are shown by systems of terraces. The present shore seems to be undergoing uplift, for parts of its beach are not reached by high tide. Marl lakes are common on the island. Soils are variable.

LOW, A. P. *Exploration of the South Shore of Hudson Strait.* Geol. Surv. Canada, Ann. Rept. Vol. XI, Part L, 47 pp., 1901. (Published as a separate in 1899.)

The glacial geology is discussed on pp. 34–47. Although the highest hills are glaciated, there is little drift material except bowlders above 400 feet A. T. The ice movement was radial toward the coast. The highest marine terrace noted is 405 feet. Reference is made to a marine limit of 700 feet at Richmond Gulf in Hudson Bay, of 300 feet at the south part of Ungava Bay, and of 325 feet at the mouth of Payne River.

LOW, A. P. *Report on the Exploration on the East Coast of Hudson Bay.* Geol. Surv. Canada, Ann. Rept., Vol. XIII, Part D, 86 pp, with 2 maps, 1902.

Describes the physical features of the coast and presents a few notes concerning the northern interior. The northern limit of forests, the climate, and

the fisheries are briefly treated. Near Cape Wolstenholme patches of perpetual snow were discovered. Three sets of striæ were noted in the Labrador peninsula, which are interpreted to indicate a transference of the center of glaciation northward, it being at an early time between the 50th and 51st parallels near the center of the peninsula, at a later time north of the 54th parallel, and still later between the 55th and 56th parallels and only about 100 miles inland from the east coast of Hudson Bay.

South of Hudson Bay two sets of striæ were noted, the older set running from northwest to southeast, thought to be the product of the Keewatin ice-field, and a later set from north-northeast to south-southwest, referable to the Labrador ice-field. A long list of striæ observed east and south of Hudson Bay is presented.

Subsidence of land accompanied, and perhaps continued subsequent to, the ice accumulation, and this was followed by an uplift which has carried the old marine shores to a maximum height of nearly 700 feet above the present sea-level. The limits, however, appear to be much lower in the northern part of the peninsula. (See preceding paper.)

MCEVOY, JAMES. *Report on the Geology and Natural Resources of the Country Traversed by the Yellow Head Pass Route from Edmonton to Tête Jaune Cache.* Geol. Surv. Canada, Ann. Rept., Vol. XI., Part D, 44, pp., 1901. (Published as a separate in 1900.)

The route described leads from the plains east of the Rocky Mountains westward over the front range of mountains. The physiography and the general character and extent of the several formations including the Pleistocene are briefly discussed. Glaciers were noted in the Selwyn Range on mountains 8,000 to 9,000 feet in height, and west from there on mountains that reach 11,000 feet. The drift deposits are heavy near Lake St. Anne, with bowlders of Laurentian granite and fossiliferous Devonian limestone brought from the north and northeast. The limits of eastern drift are placed about a mile west of Wolf Creek. Farther west the bowlders are from the Rocky Mountains. A glacier apparently flowed northward down the Athabaska valley. The highest mountains show no striæ, and their sharp angular appearance is thought to indicate that they have not been glaciated. However, a mountain 8,000 feet high, situated eight miles east-southeast from Tête Jaune Cache, was glaciated; the striæ bear south 25° west.

MCINNIS, WILLIAM. *Region Southeast of Lac Seul.* Geol. Surv. Canada, Summary Rept. for 1901, pp. 87–93, 1902.

Contains brief notes on the fall of streams, the river terraces, the outline and depth of lakes, and the features of the drift.

PARKS, W. A. *The Country East of Nipigon Lake and River.* Geol. Surv. Canada, Summary Rept. for 1901, pp. 103–7, 1902.

Several lakes were mapped, and the location of the headwaters of several rivers flowing to Lake Superior were determined. The explorations were carried through considerable territory hitherto unexplored.

TYRRELL, J. B. and D. B. DOWLING. *Reports on the Northeastern Portion of the District of Saskatchewan and Adjacent Parts of the Districts of Athabasca and Keewatin.* Geol. Surv. Canada, Ann. Rept., Vol. XIII, Parts F and FF, 48 and 44 pp., 1902.

The report by Tyrrell covers explorations in Saskatchewan and Keewatin, while

that by Dowling extends also into Athabasca. Tyrrell's report is based upon an exploration in 1896 involving a trip of about 700 miles. Notes were made on topography and agriculture as well as the several geological formations. The recent and Pleistocene deposits are briefly treated under the topics : peat beds, shore lines, Pleistocene clay, eskers, till, kettleholes. The striæ of the Keewatin and the Labrador ice-fields are discriminated. Those in the western part were made entirely by the Keewatin, while those in the eastern part, with one or two exceptions, have been made by the Labrador ice-field. How far east the Keewatin ice field extended was not clearly worked out.

Dowling's report covers an exploration in 1899 and later visits. The encroachment of the Labrador ice-field on territory previously glaciated by the Keewatin is mentioned (p. 12.) The relation of the two ice-fields to Lake Agassiz is also briefly touched upon. The beaches in the northern part of the district belong to the later ones of Lake Agassiz, and it is inferred that the ice-sheet still occupied that ground while the earlier ones were forming. In the detailed discussion glacial and lacustral deposits along Saskatchawan River are first discussed, then the features about Moose and Cormorant Lakes and along Cowan River, and after this in turn the Menago, Burntwood River, Athapapuscow Lake, Kississing River and Lake, and Churchill River. The report is of especial interest because it extends into the territory near the limits of Lake Agassiz, though it does not work out fully the relationship of the lake beaches to moraines and other glacial features.

UPHAM, WARREN, *Toronto and Scarboro Drift Series.* Am. Geol., Vol. XXVIII, pp. 306–16, 1901.

The interglacial beds are interpreted to be part of a delta with a fan-like lakeward slope, which after being built up nearly 200 feet was deeply channeled by the same streams which built them, the change from building to channeling being brought about by the relief of the streams from much of their burden of silt. It is thought that the ice was close at hand all the time, and that the whole interglacial and subsequent glacial history is comprised in a few hundred or possibly a thousand years. (For a reply to this paper see Coleman, above.)

WILSON, A. W. G. *Physical Geology of Central Ontario.* Trans. Can. Inst., Vol. VII, pp. 139–86, 1901.

About half of this paper pertains to the older rock formations, but the latter half discusses the present topographic features and Pleistocene geology of that part of the province of Ontario lying north of Lake Ontario. The conclusion is reached that the main topographic features are preglacial, and that the work of the ice-sheet is restricted to the rounding off of pinnacles, small spurs, and outlying features. The Ontario lowland is thought to owe its origin to normal weathering, and erosion rather than glacial excavation. The main drainage, it is thought, may have led westward through the Dundas valley toward the Mississippi in a direction opposite to that advocated by Spencer (J. W.). Many of the tributary valleys are traceable, though greatly obstructed and concealed by the glacial deposits. (Summary taken from review by F. D. Adams in *Geologisches Centralblatt.*)

WILSON, A. W. G. *The Country West of Nipigon Lake and River.* Geol. Surv. Canada, Summary Rept. for 1901, pp. 94–103, 1902.

Seventeen small lakes and connecting streams were mapped and the rocks of the country examined. Chief attention is given to the hard-rock geology, but glacial

deposits are briefly discussed. The river valleys are more or less filled with sand and gravel occurring occasionally as eskers or kame-like mounds. There are also extensive bowlder-strewn plains. The country explored is regarded as a partly dissected table-land with a trap-capped cuesta.

WILSON, W. J. *Western Part of the Abitibi Region.* Geol. Surv. Canada, Summary Rept. for 1091, pp. 115–28, 1902.

Describes briefly streams, lakes, soils, topographic features, surface deposits, climate, and game, as well as the hard-rock geology.

UNITED STATES.

MAINE.

MANNING, P. C. *Glacial Potholes in Maine.* Proc. Portland Soc. Nat. Hist., Vol. II, pp. 185–200, 1901.

Describes the occurrence and character of the potholes along the coast of Maine and discusses the evidences indicating their origin. (Review by F. B. Weeks. Paper not examined.)

NEW HAMPSHIRE.

HITCHCOCK, C. H. *Interglacial Deposits in the Connecticut Valley.* Bull. Geol. Soc. Am., Vol. XII, pp. 9, 10, 1901.

Interglacial is not used in the customary sense, but has reference to deposits made in the midst of an episode of glaciation. Deposits underneath the eskers are called interglacial because they were formed earlier than the eskers. There are deposits of tough clay which have been contorted apparently by pressure induced by the overlying glacier. It is thought that the features support the view that a local Connecticut valley glacier succeeded an ice-sheet which had a general southeasterly movement.

VERMONT.

FINLAY, GEORGE. *Granite Area of Barre, Vermont.* Ann. Rept. State Geologist for 1902, pp. 46–8.

Describes sand plains and eskers in the vicinity of Barre, as well as the crystalline rocks. The features are thought to support the view that one esker at least is of subglacial rather than superglacial origin.

MASSACHUSETTS.

CLAPP, F. G. *Geological History of Charles River.* Tech. Quart., Vol. XIV, Nos. 3 and 4, 1901; also Am. Geol., Vol. XXIX, pp. 218–33, 1902.

An interpretation of the causes for the very devious course of the river is presented and the several stages of development discussed. A map sets forth the probable course of pre-glacial streams in the Charles River basin and vicinity. The retreat of the ice is supposed to have been such that a glacial lake was held in this drainage basin whose extent and whose outlets varied with the position of the ice-front The several distinct levels are discussed and named. These lake outlets control to some extent the course of the present river.

CROSBY, W. O. *Origin of Eskers.* Proc. Boston Soc. Nat. Hist., Vol. XXX, pp. 375–411, 1902; also Am. Geol., Vol. XXX, pp. 1–39, 1902.

Attention is first called to the evidence obtained from existing ice-sheets. The Malaspina glacier has often been referred to as affording examples of eskers in process of formation, but as only one esker has been found in the tracts recently abandoned by that glacier, it is thought that the deposits now being made in tunnels under the glacier will, when uncovered by the recession of the ice, be cut down by streams issuing from the ice or buried by detrital material. It is concluded, therefore, that the Malaspina glacier does not afford a good illustration of the way in which eskers were formed. The Greenland ice-sheet also is found to afford no good example of eskers in process of formation.

Eskers are generally admitted to be the product of a waning stage of glaciation in which the marginal zone of ice is practically stagnant. It is suggested that this stagnant portion may be partially overridden by newly formed ice, and thus material might be carried from lower to higher levels by a shearing motion. The superglacial hypothesis of the origin of eskers is favored by the author for the following reasons: (1) Their courses are to a marked degree independent of topography, and they will maintain their normal courses even if it leads them to forsake or to cross large valleys and rise to levels far above the other types of modified drift. (2) They seldom, if ever, occupy channels in either the bed-rock or till which are referable to the streams which formed the eskers. (3) The major and minor deviations or meanders of the eskers, as well as their general trend, seem hard to account for on the subglacial hypothesis, but are natural enough for superglacial streams. (4) The great length of eskers is thought to be consistent with subglacial stream action, but not with superglacial, for superglacial streams are limited in their length only by the breadth of the zone of ablation. It is difficult to believe in a tunnel of the great length of some eskers 100 to 150 miles, and such an explanation should be accepted only as a last resort. It is thought doubtful if crevassing would extend far back in continental ice-sheet to aid the subglacial work. (5) Double and reticulated eskers seem natural to superglacial streams, but not to subglacial, though Stone thinks these reticulations occurred where the subglacial stream became locally superglacial. (6) The eskers are largely made up of distantly derived material, and differ from the underlying till, which is largely of local material.

The reviewer would call attention to the necessity either for qualifying or throwing out two of the above-mentioned reasons for favoring the superglacial origin of eskers. His observations in Ohio, Indiana, Illinois, and Michigan show that the channels, which under the second reason are said not to occur, are really present in the above-mentioned states, and are cut in the surface of the Wisconsin till. A description and map of one of these appears in Monograph XXXVIII, *U. S. Geol. Survey*, pp. 284–86, Pl. 14, 1899. The second point which the reviewer would make is that in the states just mentioned the eskers are very largely composed of local material, and have a constitution strikingly similar to the till which borders them. For notes concerning the proportion of local rocks both in eskers and till see Monograph XXXVIII, *U. S. G. S.*, pp. 78 and 286. Possibly the eskers of the states which the reviewer has examined, have had a different origin from those of New England, where the author's observations were made. The conditions in a very hilly or uneven country like New England may be different from those in the smooth districts in the states examined by the reviewer. Possibly in New England itself some eskers are of

superglacial and others of subglacial origin. (See paper by Finlay reviewed above, p. 606.)

CROSBY, W. O. *Hard-Packed Sand and Gravel.* Tech. Quart., Vol. XV, pp. 260–64, 1902.

At certain points in the Nashua valley near Clinton, Mass., deposits of sand and gravel are found which are very difficult to penetrate with the drill. An examination of samples shows that scaly fragments of schist, mica, etc., form a notable constituent in some cases, but in others the material consists very largely of angular or subangular quartz fragments. Upon experimenting with the latter under various conditions of water admixture it has been found that where there is insufficient water to fill the pores the surface tension of the water causes it to act as a cement binding the grains together, and it is thought that this affords a solution of the cause for the "hard-packed" material noted in the Nashua valley.

DAVIS, W. M. *River Terraces in New England.* Bull. Mus. Comp. Zoöl., Harvard College Geological Series, Vol. V, No. 7, pp. 278–346, 1902. Abstract published in Bull. Geol. Soc. Am., Vol. XII, pp. 483–85, 1901.

The control exerted by rock ledges or other resistant material on certain river terraces of New England is discussed in some detail, and attention is called to the bearing on the interpretation of terraces that heretofore had been referred to gradation with respect to temporary base levels. It is also shown that the arrangement of terraces in flights of steps does not depend on the stream volume, however true it may be that the stream volume has diminished during the process of terracing.

DAVIS, W. M. *Terraces of the Westfield River, Massachusetts.* Am. Jour. Sci., 4th series, Vol. XIV, pp. 77–94, 1902.

The Westfield River is taken as a good illustration of the effect of resistant obstacles in developing terraces. (See previous paper.)

FULLER, M. L. *Probable Representatives of pre-Wisconsin Till in Southeastern Massachusetts.* Jour. Geol., Vol. IX, pp. 311–29, 1901.

The supposed pre-Wisconsin till is of a very different type from the ordinary till of that part of New England. It contains about four times as much clay, and only about one-fourth the per cent. of coarse rock fragments and pebbles found in the ordinary till. In its composition a more striking dependence on the underlying rock formations is shown, and its material is also more highly oxidized than the overlying till, and often differs from it strikingly in color. Aside from the exposures noted, which are near Brockton and Stoughton, there are numerous exposures in which pre-Wisconsin age is suspected from the advanced stage of weathering of the rock fragments in the till.

HOLLICK, ARTHUR. *Reconnaissance of the Elizabeth Islands.* Ann. N. Y. Acad. Sci., Vol. XIII, pp. 387–418, Pls. VIII–XV, 1901.

The islands are composed largely of a bowldery moraine, which has points reaching altitudes of 125–150 feet above the sea, though the greater part is much lower. The moraine is thought to be a portion of the later or northern branch of the terminal moraine on Long Island, and is more recent than the moraine on Marthas Vineyard, Block Island, and Montauk Point. Considerable attention is given to the vegetation, and especially the forestry conditions.

JEFFERSON, MARK S. W. *Limiting Width of Meander Belts.* Nat. Geog. Mag., Vol. XIII, pp. 373–84, 1902.

The small Matfield River of Massachusetts was made a subject of special study, and the results are compared with published results on the moderate-sized Oder and the great Mississippi River, for each stream has meanders on its flood plain. The data concerning a few rivers having incised meanders are then examined and found to be insufficient to establish definite relations, though it is thought that the discordances might be removed by more detailed studies. The mean meander ratio is found to be 17. 6 : 1; that is a meander belt is that many times the width of the stream.

JULIEN, ALEXIS A. *Geology of Central Cape Cod.* Am. Geol., Vol. XXVII, pp. 44, 1901.

Discusses the glacial formations with special reference to the district from Chatham to Yarmouth. Attention is called to the intercalation of clays in the stratified deposits south of the morainal backbone of the Cape which have suffered some disturbance and flexure. Kettle-shaped hollows and pond basins are discussed in their relation to preglacial drainage valleys. Attention is also given to changes of level.

JULIEN, ALEXIS A. *Erosion by Flying Sand of the Beaches of Cape Cod.* Abstract Ann. N. Y. Acad. Sci., Vol. XIV, pp. 152, 1901.

Not examined.

WILSON, A. W. G. *The Medford Dike Area.* Proc. Boston Soc. Nat. Hist., Vol. XXX, pp. 353–74, 1901.

The discussion relates mainly to the crystalline rocks, but the glacial phenomena of the region are briefly described.

CONNECTICUT.

HOBBS, W. H. *An Instance of the Action of the Ice Sheet upon Slender Projecting Rock Masses.* Am. Jour. Sci., 4th series, Vol. XIV, pp. 399–404, 1902.

Discusses the abrading effect of the ice-sheet on slender masses of projecting rock along the bluffs of the Pomperaug valley of Connecticut, and trains of bowlders resulting therefrom.

NEW YORK.

FAIRCHILD, H. L. *Pleistocene Geology of Western New York.* Twentieth Rept. of State Geologist for 1900, pp. 103-39 Pls. 9–41, 1902.

The results of a special study of the Iroquois shore line between Richland and Watertown, N. Y., are first presented. The chief attention is given to the rate of differential elevation of the beach, though its constructional features are mapped in some detail. This study seems to support the conclusion that the warping of the eastern end of the Ontario basin has mostly, if not entirely, taken place since the extinction of Lake Iroquois, for the entire eastern shore seems equally tilted. The large amount of tilting considered in connection with the usual estimates of post-glacial time (10,000 to 50,000 years) would indicate that the rate of deformation has been much greater than the present rate of 0.42 foot in 100 miles in 100 years, estimated by Gilbert.

A study of the territory between Syracuse and Oneida with special reference to the higher and earlier channels cut by the overflow of the glacial waters is illustrated by a large number of photographs showing the features of these channels and of cataract basins and ancient deltas along them. The retreat of the ice being westward in this region, the eastern channels are older than the western, and they were apparently formed in regular succession westward.

A reconnaissance in the Cattaraugus-Chautauqua district along the divide between the Ohio and Lake Erie drainage throws light upon the character of the glacial drainage. Few channels cross the divide, the only important one being at Persia Siding, where waters passed from the Cattaraugus to the Conewango drainage basin. Most of the channels which drain southward head in uncut morainic drift. The explanation is found in the fact that there was southwestward escape along the ice-front for the glacial waters of this region as soon as the ice had receded a little fiom the divide. Several channels representing successively lower levels taken by waters draining a lake in the Cattaraugus basin westward along the ice-front into the Erie basin are described in the eastern portion of their course in the vicinity of Gowanda, but were not traced westward their entire length. The report closes with a brief description of drumlinoidal aggregations of drift near the head of Lake Chautaugua.

GRABAU, A. W. *Guide to the Geology and Paleontology of Niagara Falls and Vicinity* (*with a Chapter on Post-Pliocene Fossils*, by ELIZABETH LETSON). Bull. 45, New York State Museum, 284 p., 1901.

The introduction deals with the best routes for viewing the Falls region. Chap. 1 discusses the physical geography of the region and chap. 2 the life-history of the Falls, while chaps. 3 and 4 discuss the stratigraphy and fossils of the hard-rock formations, and chap. 5 (by E. J. Letson) the post-Pliocene fossils. The bibliography of ten pages forms an appendix, and this is followed by a glossary of fourteen pages. This guide-book affords a comprehensive interpretation of the region, presenting the results of the various workers in that field as well as the author's contributions and interpretations.

Certain parts of the interpretation of the drainage development are extremely hypothetical, and in the reviewer's opinion somewhat doubtful. For example, the eastern end of the Ontario basin is represented to have drained southward in Tertiary time through the Genesee (reversed). The view that the drainage of the Ontario, Erie, and Huron basins was southwestward toward the Mississippi seems to be in harmony with the latest results obtained in Michigan, though it can hardly be considered well established. The drainage of the Ontario and Erie basins toward the Mississippi in Tertiary times seems, however, to be a good working hypothesis.

GILBERT, G. K. *Summary History of Niagara Falls.* Published with topographic map of Niagara, U. S. Geol. Survey, 1901; reprinted in Am. Geol., Vol. XXVII, pp. 375–77, 1901.

As the title implies, the several events in the history of this region are briefly outlined. The St. David's channel is referred to without question as an interglacial gorge, and it is also stated that there were two times when the upper Great Lakes discharged by other lines than the Niagara River for periods of considerable length. These diversions make it necessary to lengthen the estimates of time required to excavate the gorge beyond that necessary for a continuous stream of the present capacity.

It is considered a matter of doubt whether the time is expressible in tens of thousands or in hundreds of thousands of years.

HITCHCOCK, C. H. *The Story of Niagara.* Am. Antiquarian, Jan., 1901.

The geological history is reviewed and the leading views concerning the falls themselves are briefly presented. It is estimated that the time since water began falling over the Niagara escarpment is 18,918 years, distributed as follows: Erosion of lower gorge below the cove, 6,844 years; erosion of the cove section, 937 years; erosion of the gorge of the whirlpool rapids, 7,800 years; erosion from the railroad bridges to the existing cataract, 2,962 years. In addition to this 475 years is estimated for the wearing out of the whirlpool basin.

MARTIN, J. O. *The Ontario Coast between Fairhaven and Sodus Bays, New York.* Am. Geol., Vol. XXVII, pp. 331–334, with map, 1901.

Describes the encroachment of the shore of Lake Ontario upon the drumlins and the building of beaches between the drumlins with materials cut from them. The shore has advanced at least one-fourth to one-half mile since the lake has had its present level, and the rate of cutting varies from a few inches to ten feet a year.

OGILVIE, I. H. *Glacial Phenomena in the Adirondacks and the Champlain Valley.* Jour. Geol., Vol. X, pp. 397–412, with map, 1902.

Striæ indicate that the Champlain–Hudson valley ice-lobe spread southwestward into the Adirondacks, and there appears to be no change in direction resulting from differences in altitude. There was very little scouring by the ice in the valleys of the interior of the Adirondacks. Variations in the glaciation are separable into three zones: (1) a zone of abundant striation, though variable bearing, along the Cham plain valley; (2) a zone along the gneissic hills in which striæ are not numerous, but are uniform in bearing (northeast–southwest); (3) a zone among the high anorthosite peaks where striæ are lacking, but the mountain tops are smooth.

The glacial deposits are largely of stratified material. A glacial lake which occupied the Champlain valley has its shores marked by large delta accumulations at each of several lake levels. This glacial lake was followed by an incursion of the sea, which brought in a marine fauna.

There appears to have been a glacial gathering ground in the interior of the Adirondacks late in the Glacial epoch, and its local glaciers built up small moraines across a few valleys.

The drainage lines were begun far back in geologic time. The lakes are generally partially filled preglacial valleys, broadened perhaps by ice action.

SALISBURY, R. D. *New York City Folio, Pleistocene Formations.* Geol. Atlas of the United States, U. S. Geol. Survey, Folio No. 83, pp. 11–17, 1902.

The four fifteen-minute quadrangles in the New York City Folio are covered by glacial deposits and glacial outwash except a small driftless tract of scarcely one square mile near New Dorp on Staten Island. On this driftless tract is a gravel deposit of late Pliocene or early Pleistocene age which is referred to the Beacon Hill or Bridgeton formation. Gravel of the Pensauken formation is exposed under glacial deposits in clay pits around Kreisherville, Staten Island, and by the waves in the cliff

at Princess Bay Light. The Pensauken is thought to be no older than some of the glacial deposits, though not of glacial origin.

The growth of the ice-sheet, the recurrent glaciations, and the characteristics of glacial drift are briefly discussed before taking up the features and deposits found within the New York area. The topography, topographic relations, and composition of the moraine on Staten and Long Island, the stratified drift south of the moraine, and the ground moraine to the north, are discussed in some detail, after which striæ, mixed drift, and stratified drift north of the moraine are considered, and attention is called to a surface loam, which, it is thought, may have originated in several different ways. Gravel near Rockaway on Long Island, though nonglacial, is thought to be of late Glacial age or even younger, and is correlated with the Cape May formation. The oscillation of the land, stream erosion, shore erosion, and weathering in postglacial time are then considered. The evidence concerning land oscillation is found to be indecisive. The slight amount of weathering of the drift surface, of stream erosion, and shore erosion testify to the briefness of the postglacial epoch.

STEVENSON, A. E. *Glacial Action in Schoharie Valley.* Ann. N. Y. Acad. Sci., Vol. X, 1901.

Not examined.

UPHAM, WARREN. *Preglacial Erosion in the Course of the Niagara Gorge and its Relation to Estimates of Postglacial Time.* Am. Geol., Vol. XXVIII, pp. 235–44, 1901.

The St. David's channel is thought to be preglacial rather than interglacial, because of its wide mouth. Fish Creek, a small eastern tributary of the Niagara, entering just south of the Niagara Escarpment, is thought to be occupying a preglacial valley which continued in the course of the Niagara River (reversed) to connect with the St. David's channel at the whirlpool. This would render but a small amount of rock excavation necessary in opening a part of the gorge below the whirlpool, and would materially affect estimates of the length of postglacial time. On the assumption that much of the northward differential uplift followed very closely upon the ice retreat (an assumption which Fairchild's observations at the east end of Lake Ontario show to be unfounded for that region) Upham concludes that the three upper lakes could not have discharged through either the Trent or the Mattawa valley, and considers the erosion of the Niagara gorge the work of a stream whose volume never was much less than the present and for the early part of the erosion was much greater. From this it is reasoned that postglacial time has been very brief, 7,000 years being considered ample for that part of it involved in cutting the Niagara gorge.

WOODWORTH, J. B. *Pleistocene Geology of Portions of Nassau and Queens Counties, New York.* Bul. 48, N. Y. State Museum, pp. 53, 1901.

This bulletin is the first of a series which is planned for the discussion of the Pleistocene geology of the eastern part of New York. It embraces a discussion of topographic features, glacial deposits, Pleistocene history, and postglacial changes and processes now in action, but deals mainly with the Pleistocene deposits.

The topographic features embrace a morainic system with two ridges separated by a sand plain, and south of this morainic system an extensive outwash plain sloping from a morainic border to the sea. North of the morainic system is a tract of uneven

drift, coated generally by till, but having thick deposits of sand and gravel underneath the till.

The glacial deposits exhibit three marked phases of Pleistocene history: (1) a group of old gravels and sands with an intercalated till bed, the group considered to be the equivalent of the Columbia formation of the Atlantic coastal plain; (2) a deglaciation interval with marked erosion; (3) the moraines and their attendant stratified gravels and sands of Wisconsin age forming the topographic details of the surface.

No decisive local evidence was found concerning the relation of land to sea-level during the deposition of the old gravels and sands, but subsequent to deposition they appear to have been channeled by open-air streams. In the subsequent ice advance the land appears to have been as high as now, if not higher. During the retreat of the ice temporary lakes existed back of the moraine, one of which stood at 80 feet above sea-level, and its successor at a lower level. Possibly the lower body was at sea-level. Glacial action ceased with the retreat of the ice across East River. The streams on the outwash plain south of the moraine flow in courses which appear to have been carved by the more vigorous glacial streams, while those on the north slopes are, in some cases, apparently in partially filled interglacial channels. Modern marine action has encroached on the south edge of the outwash plain and thrown bars of sand and gravel across the old glacial stream channels. There are two lines of evidence pointing to a sinking of the coast in recent time, one being the occurrence of peat beds below present sea-level, the other the absence of wave cutting at present sea-level on points which stand back of the recently formed barrier beaches.

WRIGHT, G. F. *The Rate of Lateral Erosion at Niagara.* Am. Geol., Vol. XXIX, pp. 140–43, Pls. 6–8, 1902.

Measurements of the amount of crumbling and recession of the shale portion of an unprotected part of the wall of the Niagara gorge from 1854–1898 indicate a marked change, the average of fifteen measurements in the Clinton Shale showing extreme erosion of 3 inches per year, and the average of eleven measurements in the Niagara Shale 3¼ inches per year. Taking the entire exposed face into consideration, the average rate for the Clinton and Niagara shales is estimated to be 1½ inches per year. As these are unprotected by talus or vegetation, the allowance of such protection was estimated, and is thought to possibly reduce the rate of recession of the walls of the gorge to one-seventh that of an unprotected slope, but not more. This would give one-fourth inch per year, which is all that would be necessary to accomplish the actual enlargement of the mouth of the Niagara gorge in 10,000 years, and that is what the author set out to demonstrate by these measurements.

NEW JERSEY.

SALISBURY, R. D. *The Glacial Geology of New Jersey.* Final Report of State Geologist, Vol. V, xxiii, 802 pp., 66 Pls., and 102 figs. in the text, Trenton, 1902.

The volume consists of two parts, a general discussion and a discussion of the local details. In the general discussion the glacial formations and questions pertaining to glaciation are taken up. It differs from the author's papers already published in the JOURNAL OF GEOLOGY in containing numerous references to the glacial deposits

of New Jersey. It is such a presentation of glacial geology as will be of much use in class work in universities and colleges, and at the same time is of interest and easy comprehension to the general reader. The reviewer hesitates to refer to certain misleading statements (which appear on pp. 183–86) in a work which otherwise is so accurate and comprehensive. The Iowan drift is but little more weathered and eroded than the Wisconsin, and cannot be separated from it by the long interval mentioned in this report. The Illinoian drift-sheet which in this report is doubtfully admitted to rank with the Kansan, Iowan, and Wisconsin, really marks the culmination of the Labrador ice-field, and is no more due to a local advance than is the Kansan drift-sheet which marks the culmination of the Keewatin icefield.

The discussion of local details opens with a description of the terminal moraine of the Wisconsin drift-sheet throughout its course across New Jersey, after which are considered in turn the drift of the Appalachian province, of the Highlands, and of the Triassic plain, in each of the several phases which are exhibited. Recessional moraines were traced for short distances in the Appalachian province and in the Triassic plain, but the tracing was not carried far enough to bring out, as has been done in states west of the Appalachians, the successive positions of the ice-border in its retreat. It appears from the scant notice given these later moraines that they constitute very inconspicuous features. After discussing the drift north of the terminal moraine, the stratified drift of late glacial or Wisconsin age lying south of the moraine is considered. It includes not only valley gravel and overwash gravel plains, but also lacustrine clays and silts, subaqueous overwash, kames, and certain deposits attributed to icebergs.

An old sheet of extra morainic drift, which has been described somewhat fully in the *Reports of Progress* for 1892 and 1893, is briefly considered in this final report. It is found to be discontinuous or patchy, and in this respect is strikingly in contrast with the drift-sheet north of the moraine. It is estimated that about four-fifths of the surface north of the moraine is deeply covered with drift, while about the same proportion south of the moraine is nearly destitute of drift. In lithological make-up the extramorainic drift is not greatly different from the drift in and north of the moraine. But much of it is more highly oxidized and weathered than the moraine and drift-sheet to the north. It is thought that the most highly weathered drift is at least as old as the Kansan drift of the western states.

MARYLAND.

SHATTUCK, GEORGE B. *The Pleistocene Problem of the North Atlantic Coastal Plaiu.* Johns Hopkins Circulars No. 152, May, 1901; also Am. Geol., Vol. XXVIII, pp. 87–107, 1901.

Results of studies by McGee, Darton, and Salisbury are reviewed and attention called to lack of harmony in the interpretations, and to changing views that have been advanced. The author fails to find evidence of such complexity as his predecessors have discovered, and considers the simple interpretation of marine action at different levels sufficient to account for all the phenomena. Certain features which one of his predecessors had interpreted to be unconformities pointing to a period of elevation and subaerial erosion the author thinks to be due to slight changes in current or freshet conditions differing in no way from the ordinary cross-bedded structure. An excursion into New Jersey confirmed the author in his view that the simple

interpretation of marine action furnishes as complete a solution there as in Maryland, and he expects this interpretation ultimately to find application over much of the Atlantic coastal plain.

WEST VIRGINIA.

CAMPBELL, M. R. *The Huntington Folio.* Geol. Atlas of the United States, U. S. Geol. Survey, Folio 69, 1901.

Drainage and Pleistocene deposits are the topics pertinent to this review. The Huntington Quadrangle includes several streams with an unsymmetrical arrangement in their respective basins, which is explained by tilting. This quadrangle includes also a part of the well-known Teazes or Teays valley, the former course of Big Kanawha River. The diversion of the river into its present course is referred to an ice-gorge near Milton, and so is the heavy accumulation of silt in the abandoned valley, which is here given the name Teay formation. The gorging is thought to have been accomplished by river ice concurrent with the culmination of glaciation in the adjacent part of the glaciated region. The same ice gorge is thought to have caused Hurricane Creek to continue northward past Teays valley in a course parallel with that of the diverted Kanawha. An ice-gorge on Guyandotte River near the Lincoln-Wayne county line is thought to have diverted the stream to a course a short distance east of the old one. This river sustained another diversion near its mouth in passing across Teays valley, which, however, is not mentioned. In support of the view that these diversions were caused by ice-gorges, the smaller amount of silt below the site of the supposed gorging in Teays valley is brought forward. The reviewer, however, doubts whether there was a smaller deposition in this valley below the site of the supposed gorge than above. There is still a heavy deposit in part of this lower course near where the Guyandotte River has been diverted, and Mud River has apparently removed much of the silt between there and Milton. The value and applicability of this new hypothesis remains to be determined. In Monograph XLI, *U. S. Geological Survey* (pp. 105, 106), the reviewer called attention to the fact that the silting was sufficient to build the valley up to a level as high as low cols in the district north of it, thus making it possible for a stream to take a new course without having to open a channel.

The Teay formation or silt deposit which graded up the old course of the Big Kanawha is a fine deposit overlying coarse material such as commonly characterizes river beds. It has a depth of about sixty feet where best preserved from erosion, as is the case near Hurricane village.

New Ichthyosauria from the Upper Triassic of California. By J. C. MERRIAM. University of California Publications, Bulletin of the Department of Geology, Vol. III (1903), pp. 249–63, Plates XXI–XXIV.

THE interesting discoveries made by Dr. Merriam, during the past few years, of many new and strange forms of Ichthyosauria from the Californian Triassic have added much to our previous knowledge of this remarkable order of reptiles. To the six species of *Shastosaurus*